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CS 118

Homework #1

**Problem 1**

Part A: The infinite sum of the absolute value of the coefficients is proportional to the area under the curve of one period of the square wave function. Since the square wave is bounded, the infinite sum must converge, so the coefficients must decrease as “n” increases.

Part B1:

Chart, line chart

Description automatically generated

Link to Desmos: <https://www.desmos.com/calculator/xkfwju7rxs>

Part B2:

Note that for all 5 approximations.

For approximation 1 (n = 1), , so the bandwidth is .

For approximation 2 (n = 2), , so the bandwidth is .

For approximation 3 (n = 3), , so the bandwidth is .

For approximation 4 (n = 4), , so the bandwidth is .

For approximation 5 (n = 5), , so the bandwidth is .

Part B3:

For n = 1, the lowest value between 0.1s and 0.4s is 0.588V, which results in 41.2% error.

For n = 2, the lowest value between 0.1s and 0.4s is 0.667V, which results in 33.3% error.

For n = 3, the lowest value between 0.1s and 0.4s is 0.693V, which results in 30.7% error.

For n = 4, the lowest value between 0.1s and 0.4s is 0.700V, which results in 30.0% error.

For n = 5, the lowest value between 0.1s and 0.4s is 0.704V, which results in 29.6% error.

We see that percent error decreases with better approximations.

Part B4:

For n = 1, the wave reaches 0.9V at t = 0.1782s.

For n = 2, the wave reaches 0.9V at t = 0.0985s.

For n = 3, the wave reaches 0.9V at t = 0.0674s.

For n = 4, the wave reaches 0.9V at t = 0.051s.

For n = 5, the wave reaches 0.9V at t = 0.041s.

**Problem 2**

Part 2.1: Slow rate of every 2 usec

Chart, line chart

Description automatically generated

The receiver outputs 101.

Part 2.2: Fast rate of every 1usec.

Chart, line chart

Description automatically generated

The receiver outputs 101.

Part 2.3: Super-sonic rate of every 0.5us.

Chart, line chart

Description automatically generated

There is inter-symbol interference at the sample instance at 1.5us.

The receiver outputs 111.

**Problem 3**

Part 3.1:

Part 3.2: The 10th sampling is at t = 9.5us. The 10th bit will start at t = 9.72us because of the slower sender clock. Therefore, the sample is off by 0.22us.

Part 3.3: